(e) each of said pistons having a length l_k that satisfies the equation:

$$l_k \geq h \cdot \frac{p_f}{p_k}$$

where h is the maximum depth of immersion of each piston and cylinder assembly, p_f is said first density of said liquid, and p_k is said second density of the material from which said piston is formed.

Amend claims 17 and 18 to read as follows:

17. Apparatus as defined in claim 13, wherein one of said deflection wheels includes a rotably mounted axle (14), said output shaft being connected with said axle.

18. Apparatus as defined in claim 13, wherein the pistons and cylinders of all of said assemblies have the same dimensions, respectively.

REMARKS

Claims 13, 17, and 18 now remain in the application, the subject matter of cancelled claims 14, 15, 16, and 19 have been incorporated in amended claim 13.

Allowance of the amended claims is courteously solicited for the following reasons.

According to Applicant's invention as recited in the amended claim 13, the transport means 13, 33, 11 for transporting the opposed pairs of piston and cylinder assemblies is completely submerged within the liquid having the first density (p_f) (Page 6, lines 11-16). This is in keeping with the teachings of the known gravity-actuated fluid displacement power generating systems of the cited patents to Diamond No. 3,934,964 and Kusmer No. 3,412,482, among others. Accordingly, in Applicant's invention, there is no "impact of hitting the surface of the liquid with the piston-and-cylinder unit (12) at the lower deflection device (30) point when entering the liquid," as proposed by the Examiner on Page 3 of the Office Action.

Amended claim 13 further recites the output shaft 14 which may be connected, for example, with an electrical generator (Page 4, lines 36-38, and Page 10, lines 9-14).

Regarding the Examiner's inquiry regarding the issue of friction, the present invention uses the forces of buoyancy to generate torque (Page 1, lines 7-9). As stated on Page 2, lines 11-25:

> "In principle, the apparatus according to the invention can be operated in any fluid which, with practicable changes in the volumes of the bodies, supplies a sufficiently large increase in buoyancy for at least the frictional forces acting in the apparatus to be overcome. Preferably, however, provision is made for the bodies to be immersed in a liquid during at least part of their rotational movement. As a result of the at least partial but expediently complete arrangement of the apparatus in a liquid, especially in water, a relatively large increase in buoyancy can be achieved even with a relatively small change in volume. For example, an increase in the volume of individual bodies by in each case 1 dm^3 (1 1) supplies an increase in buoyance of 9.81 N (1 kp)." [Emphasis added.]

Owing to the connection between the chambers of the associated pairs of piston and cylinder assemblies, during the change of direction of movement of the pistons during transport around the deflection wheels, "an additional pressure on the piston assists its movement into the extended position in order to increase the volume and compensate for any frictional losses arising" (Page 3, line 29, to Page 4, line 3).

Applicant's invention is characterized by the provision of pistons formed from a material such as steel (Page 9, line 36) having a density P_k that is relatively high, said pistons having a length determined by the equation

$$l_k \geq h \cdot \frac{p_f}{p_k}$$

where h is the maximum possible depth of immersion of the piston and cylinder unit (Page 8, lines 7-20).

It is courteously contended that Applicant's invention as defined in the amended claims is clearly patentably distinguishable from the cited prior art.

The British patent No. 35,705 fails to teach pistons that are sliding in cylinders for increasing and decreasing the volume of respective bodies.

As can be easily seen from the drawings, each of the bodies consists of a bellows that can be compressed or expended by a weight that is connected thereto by a lever (cf. particularly Figs. 3 to 5).

Such a weight is surrounded by the medium into which it is immersed. Therefore, it is not comparable with a piston arranged in a cylinder in such a way that only one surface of the piston is in contact with the fluid.

Similarly, the Kusmer patent No. 3,412,482 teaches expansible and compressible gas chambers each equipped with a biasing weight. The biasing weight 16 as shown in Fig. 5 looks like a piston, but is not a piston in the sense of the present invention. In particular, as can be seen from Figs. 1 and 5, the weight 16 is not arranged in a cylinder but in a cage 15 so that the water 17 in the tank 18' is in contact with most of the outer surface of the weight 16 except that part of the surface that is closing one end of the bellows 14.

Therefore, Kusmer fails to teach the condition as defined in the amended independent claim 13.

The gravity-actuated fluid displacement power generator taught by Diamond No. 3,934,964 comprises a plurality of piston-cylinder-units. The piston of each of these units is a freely sliding piston actuated within the cylinder by gravity to change the weight of the piston-cylinder-unit by removing a heavier fluid and replacing it with a vacuum or a lighter fluid to reduce the weight of the piston-cylinder-unit below that of the displaced fluid medium (cf. column 1, lines 17 to 23).

Furthermore, according to the description of Figs. 1 to 3, the pistons 22c and 28c slide within the respective cylinder 22b and 28b to change the effective volume of the piston-cylinder-units 22, 28 as described in column 4, lines 28 to 37. However, although it is described that the movement of the piston 28c of the lower piston-cylinder-unit 28

is such that it completes its movement during the change of its moving direction from downward moving to upward moving, we think that the movement of the piston will not be completed at the maximum debts of immersion of the piston-cylinder-unit but only when the piston cylinder unit reaches a higher lever because the length of the pistons seems to be insufficient to comply with the respective requirement of present claim 13.

In particular, Diamond uses relative short pistons compared with the cylinder length so that it is possible to bring a piston-cylinder-unit into a floating condition by moving the piston into its full extended position. Because of the necessity of the relative short length of the piston, it is assumed that - other as shown in the drawings - the piston cannot move into its full extended position; i.e., the position abutting against the flange 34 at the lowermost position of the piston-cylinder-unit.

In contrast, as discussed in the paragraph bridging Pages 9 and 10 of the present application on a maximum depth of immersion of about 2 m requires a piston length of about 0.25 m in case that steel is used for the piston. Using a lighter material as aluminum, the piston length has to be further increased.

Applicant courteously contends that although the apparatus taught by Diamond may work, it will not work at same efficiency as the apparatus of the present invention since the pistons are not formed in accordance with the requirement of claim 13 that improves the efficiency of the inventive apparatus compared with the prior art devices.

Accordingly, it is courteously contended that Applicant's invention as defined in the amended claims is clearly structurally distinguished from the cited prior art.

Attached hereto is a mark-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "**Version with Markings to Show Changes Made**."

Favorable action is courteously solicited.

Respectfully submitted,

12/3, 2001

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Claims

Cancel claims 14, 15, 16, and 19, and amend claim 13 to include the subject matter thereof, as follows:

13. A torque generating apparatus, comprising:
(a) a container containing a liquid having a first density (p_f);
(b) [a least one pair of first] a plurality of pairs of piston and cylinder assemblies (12) each submerged within said liquid;
(c) transport means (10) [including a rotationally mounted output shaft (14)] connecting said pairs of piston and cylinder assemblies for rotational movement in opposite vertical directions relative to a horizontal axis, each of said assemblies including a cylinder (20) containing a chamber (16), and a piston (21) slidably mounted in said chamber for alternate displacement by gravity in a first direction to increase the effective volume of said chamber during upward movement of said assembly, and to decrease the effective volume of said chamber upon displacement by gravity in the opposite direction during downward movement of said assembly, said piston being formed of a material having a second density (p_k) that is appreciably greater than said liquid first density[;] said transport means being completely submerged within said liquid and including:
(1) a pair of vertically spaced deflection wheels (13, 33) having parallel horizontal axes of rotation, one of said deflection wheels being connected with an output shaft (14);
(2) an endless transport member (30) mounted on said deflection wheels, said pairs of piston and cylinder assemblies being mounted successively at opposite locations on said endless transport member, respectively;
(3) the sum of the effective volumes of the chambers of said pairs of piston and cylinder assemblies being constant during the displacement of said assemblies;
(4) the positions of the pistons of each pair of assemblies relative to their associated cylinders being automatically reversed when the assemblies are transported by said endless transport means around said deflection wheels, respectively;

(d) conduit means (17) connecting said chambers of said [first pair] pairs of piston and cylinder assemblies, said chambers containing a fluid having a third density that is less than said liquid first density, whereby during the relative vertical displacement of said pistons within their associated cylinders, respectively, said second fluid is displaced from the chamber having the decreasing volume to the chamber having the increasing volume;

(e) each of said pistons having a length l_k that satisfies the equation:

$$l_k \geq h \cdot \frac{p_f}{p_k}$$

where h is the maximum depth of immersion of each piston and cylinder assembly, p_f is said first density of said liquid, and p_k is said second density of the material from which said piston is formed.

Amend claims 17 and 18 to read as follows:

17. Apparatus as defined in claim [16,] 13, wherein one of said deflection wheels includes a rotably mounted axle (14), said output shaft being connected with said axle.

18. Apparatus as defined in claim [16,] 13, wherein the pistons and cylinders of all of said assemblies have the same dimensions, respectively.